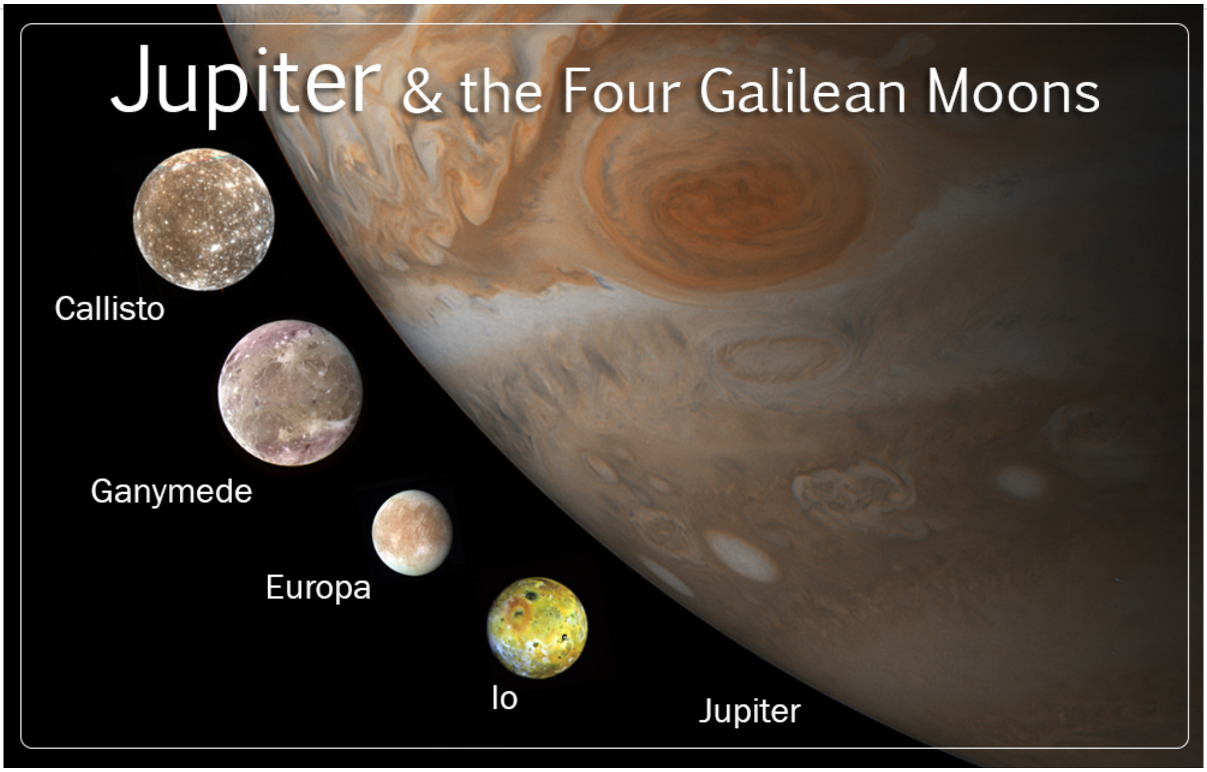
# 12.1: The Galilean Moons




Galilean Moons. https:/commons.wikimedia.org/wiki/File:Galilean_Moons_Infographic_(16459663809).jpg;

Figure 12.1.1: Copy and Paste Caption here. (Copyright; author via source)

The Galilean moons of Jupiter are so named because they were discovered by Galileo in 1610. All four are named after romantic conquests of the Roman god Jupiter. The inner three of these moons are locked in orbits that form a 1:2:4 orbital resonance. This resonance increases the amount of tidal stresses the moons experience, further driving internal activity. Every seven days, the three moons line up, creating a series of tugs that add up, making all three orbits elliptical.

## 12.1.1 Io

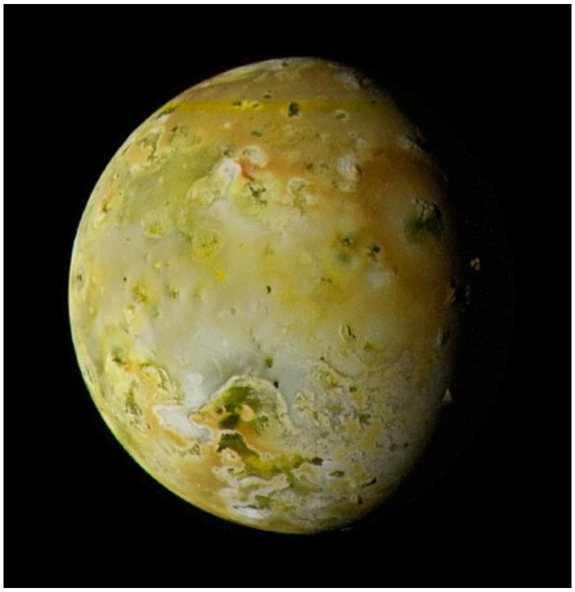
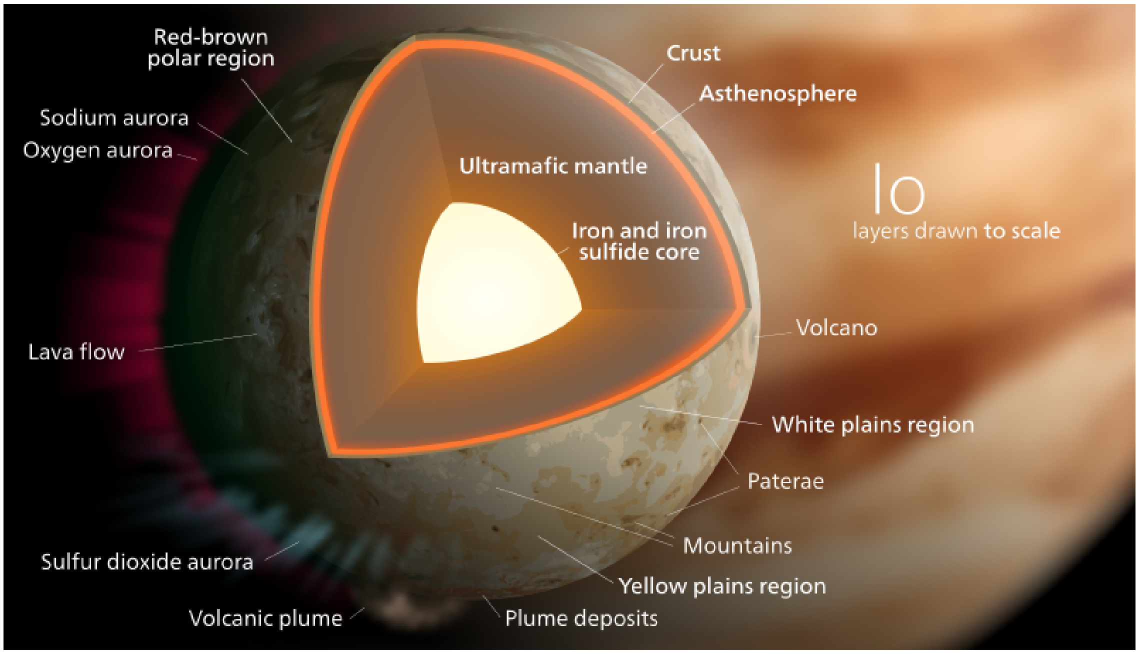


Image of Io from the Galileo probe.

https:/commons.wikimedia.org/wiki/File:Io_-_October_16_2001_(28120329089).jpg;

Io is the innermost moon and is the densest of Jupiter’s moons. Io is also the most geologically active object in the Solar System, with many active volcanoes. When the Voyager probes first returned photographs of Io, scientists were amazed that Io appeared to have an ever-changing surface. It never looks the same way twice. In fact, Io can change surface features in a few weeks. It has no craters as they fill in too fast, giving Io the youngest surface of any solar system object. Gravity from Jupiter as well as from Europa subjects Io to tremendous tidal forces. The tides are so strong on Io that they left the crust itself. During a single 41-hour orbit, the surface of Io can rise as much as 300 feet.  These tidal forces power the volcanoes on Io.

Io’s interior include three main layers: a curst, a rocky mantle, and a core made of iron and iron sulfide.




Io and its interior

https://commons.wikimedia.org/wiki/F...Io_diagram.svg

### 12.1.2 Europa

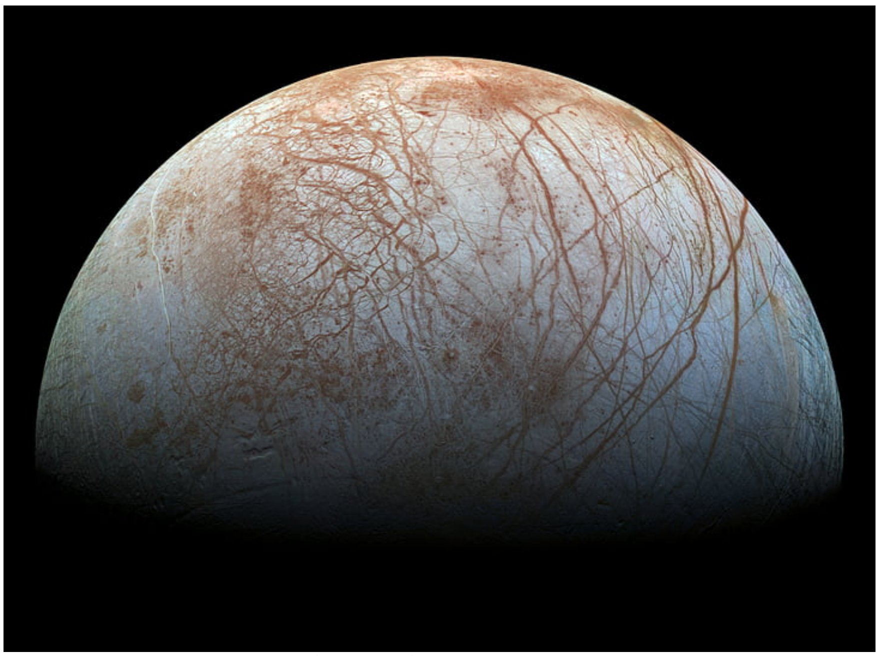
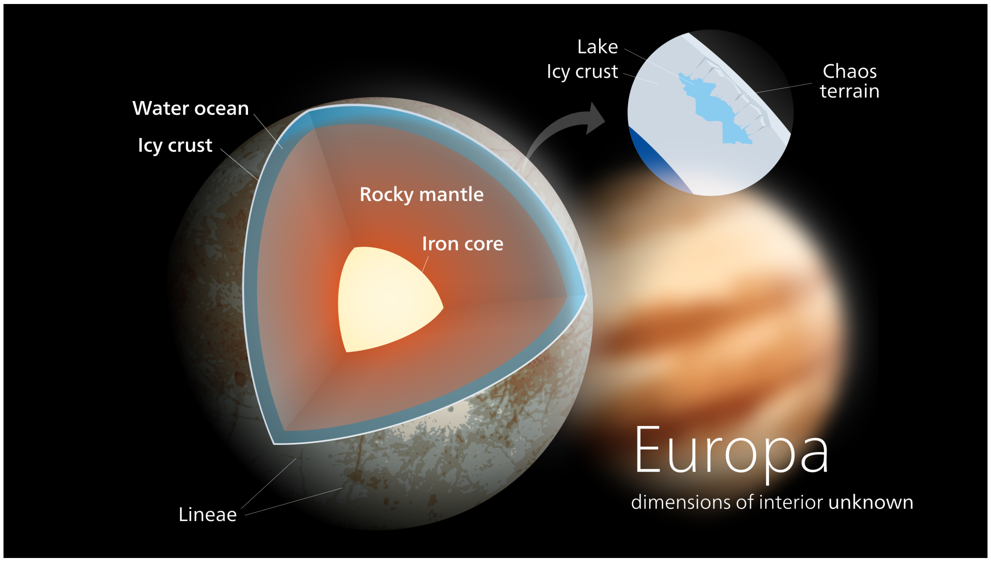


Image of Europa from the Galileo probe.

https:/www.pickpik.com/jupiter-moon-europa-icy-space-cosmos-astronomy-137142;

Europa, like Io, has no craters. Its surface is covered with water ice. Tidal forces stress and crack ice. This creates water flows that keep surface relatively flat with many ridges across its surface. Europa's interior also warmed by tidal heating and there is substantial evidence that there is a layer of liquid water beneath the surface. There may be more liquid water on Europa than in all of Earth's oceans. The friction from tidal action may also be a source of energy that could be utilized by living organisms, much like microbes use heat from dent undersea volcanic vents a source of energy. We have no evidence that Europa has life, but the potential is there. Planetary scientists hope to one day land a probe on Europa and drill through the ice in order to see if there what really is under that crust.

Underneath the icy crust and possible water layer, Europa has a rocky mantle and an iron/iron sulfide core.




Europa and its interior

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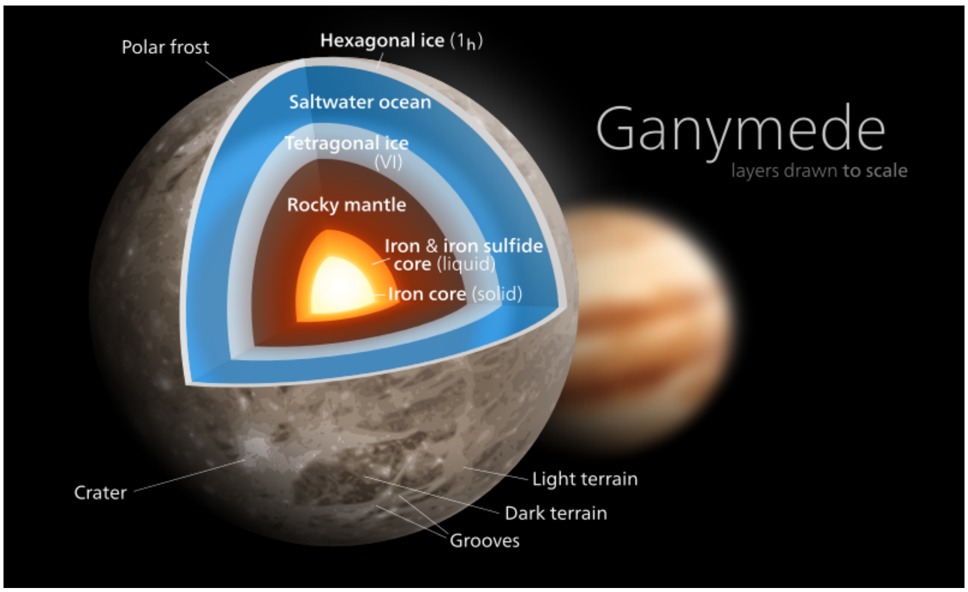
## 12.1.3 Ganymede




Ganymede and its interior

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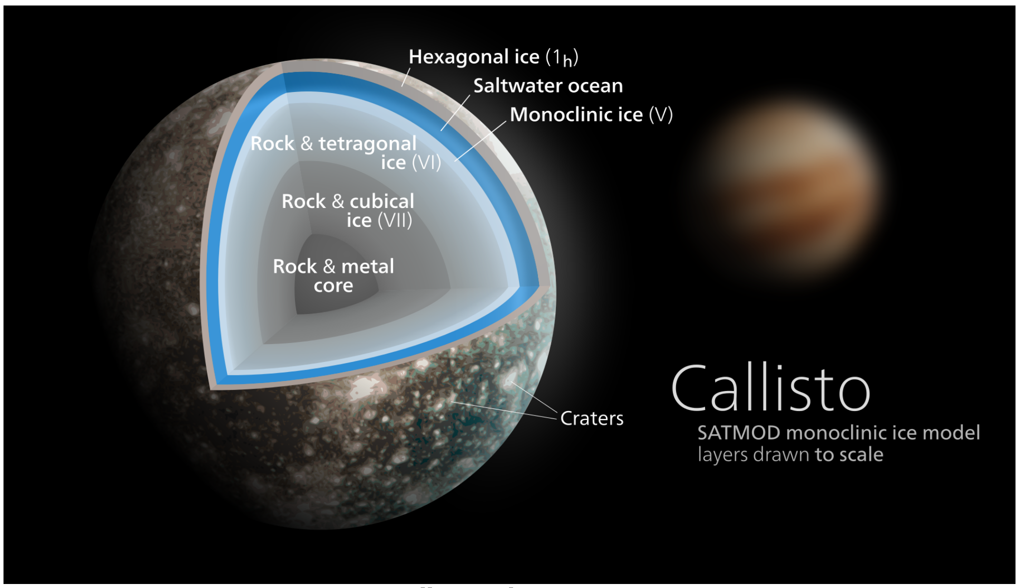
Next out from Jupiter is Ganymede, the largest moon in the Solar System. In fact, Ganymede is larger than Pluto and Mercury. If it orbited the Sun alone, Ganymede would be considered a planet. Ganymede's surface and history looks similar to that of Earth's Moon, but with a surface of water ice instead of lunar rock. Ganymede has few craters, giving evidence of resurfacing. Curiously, Ganymede has a magnetic field, which is unusual for moons.

Beneath Ganymede's icy crust may also be a water layer. Beneath that, Ganymede has a rocky mantle and an iron/iron sulfide core.

## 12.1.4 Callisto




Callisto and its interior

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The fourth Galilean moon is Callisto, which looks similar to Ganymede but with heavy cratering and no evidence of resurfacing activity. Another strange feature of Callisto is that it appears to be an undifferentiated mixture of rock and icy material Callisto's low density (only twice that of water ice) can only be explained by a composition of roughly equal parts ice and rock, with no metallic core like Ganymede's. Evidence for its lack of a dense core was found my measuring its gravitational pull on the Galileo spacecraft. We would expect that all the big icy moons would be differentiated. The heat released from the collisions from its formation should have melted it, causing the dense, metallic materials to sink to the core. In fact, it should be easier for an icy body to differentiate than for a rocky one because the melting temperature of ice is so low. It would take only a little heating will soften the ice and get the process started, allowing the rock and metal to sink to the center while the slushy ice floats to the surface.  Yet Callisto seems to have frozen solid before the process of differentiation was complete. How this happened is still a mystery.